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The Study of Resource Saving Technologies in the Processing of Grapes

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Abstract

On average, about 160 thousand tons of grapes are produced annually in Azerbaijan. If you process all these grapes, you will get about 22 thousand tons of seeds and about 6 thousand tons of brushes. These products, which have a rich composition, are called second stocks of raw materials. But due to the lack of cost-effective and affordable technologies that meet local conditions, thousands of tons of products are thrown away as waste every year. Although the research has produced important results in the field of residue research and processing, it has not been able to provide a fundamental solution to the problem for all regions. In particular, there was no research or assessment of the composition of residues generated during processing of some indigenous and introduced grape varieties grown in local conditions. The study used bones obtained after processing native (Madras and Bayanshiri) and introduced (Isabella and Merlot) grape varieties grown in local conditions. Studies were conducted on fresh and dried bones. The composition of the skin of the studied grape varieties, the spectra of bark extracts of different wavelengths, as well as the chromatogram of hydrolysates of the peel were determined. At the same time, similar studies were conducted on grape seeds. It turned out that the components of bones have a rich composition, by extracting the compounds contained in them, they can be returned for reuse. Studies conducted to extract substances from the components of the bones allowed to obtain extracts rich in various substances (sugar, nitrogen, pectin, phenolic compounds, fats, fiber, minerals, etc.). Extracts obtained in separate technological modes with various extractants were used in the production of food products for various functional purposes and received positive results.

Keywords: Grapes; Juice; Bones; Comb; Skin; Seeds; Sugar; Acid

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Introduction

Despite the fact that Azerbaijan is historically considered one of the ancient States where viticulture and winemaking are developing, the highest level of development of this area occurred in the 80^{th} of the last century. Over the years, the country has produced more than 2 million tons of grapes from an area of about 260 thousand hectares. But at the end of the last century and the beginning of this century, the region suffered great losses and experienced decline. Currently, constant work is underway to eliminate it [1].

The" State program for the development of winemaking in the Republic of Azerbaijan for 2018-2025 “assesses the wine sector as one of the oldest and most profitable areas of the agro- industrial complex. According to the program, the production of export-oriented wine productsin the country should be increased several times [2]. Increasing the production of juices and wines will also lead to an increase in the amount of waste generated during the processing of grapes. It is known that when processing grapes, about 25 p.c. of waste is obtained, which is a very large mass in the total production volume. According to its rich composition, these wastes are called secondary raw materials [3].

The main mass of secondary stocks formed during the processing of grapes is the seed stone. So, at this time, 3-7 p.c. of the brush is formed, 15-20 p.c. - the skin, 3-6 p.c. - the seeds, depending on the weight of the grapes. The number of seeds in grape seeds pie is 20-25 p.c. of its weight [4,5]. Useful properties of biologically active compounds were found in the residues both *in vitro* and *in vivo*. Complex methods of extracting phytochemicals contained in waste and their use in human health were evaluated [6].

But due to the lack of cost-effective and affordable technologies that meet local conditions, thousands of tons of products are lost without use every year. Sometimes these residues are released near processing plants, polluting the environment and creating unsanitary conditions. Therefore, there are economic and environmental bases for the effective use of such residues [7].

Although the research has produced important results in the field of residue research and processing, it has not been able to provide a fundamental solution to the problem for all regions. In particular, there was no research or assessment of the composition of residues generated during the processing of some indigenous and introduced grape varieties grown in local conditions. As you can see, the field faces an important scientific problem that needs to be solved in local conditions.

Purpose of work

Research and assessment of the composition of residues formed during the processing of some native and introduced grape varieties grown on large territories in local conditions.

Materials and Methods

The object of research is considered to be native and introduced grape varieties grown in the country and formed during their processing of bones, skins, and seeds. Bones remaining after processing grapes are dried in the sun and in a drying cabinet. Then the dried bones are ground into a powder in a coffee grinder and passed through a fine-grained (0.3-0.5 mm) sieve. The resulting powder from seed pips is stored in plastic bags at a temperature of minus 20°C before analysis. When analyzing the composition, we used generally accepted, new, and modified methods of analysis [8].

In the conditions of micro-processing obtained after pressing the juice, the grape skin is cooled by hand and separated. Separated grape skins are frozen and dried at a temperature of minus 40°C for 24-48 hours. Before analysis, the skin samples are ground into a powder. To extract samples of grape skins, we use 50 p.c. methyl alcohol 2 and 1% hydrochloric acid, as well as 50 p.c. methyl alcohol 2 and 1 p.c. acetate acid with solvents. For extraction of samples of dried bones with hydrochloric acid solutions, 0.25 g is taken; for extraction with acidic acetate solvents, 0.35 g. after extraction, their volume is reduced to 25 ml using extraction filters.

For the hydrolysis of grape QL samples, 50 p.c. methyl alcohol, 70 p.c. alcohol, and 2 p.c. chloric acid extract are regulated. For the final result, 50 p.c. methyl alcohol and 1.2 m HCl are regulated and hydrolyzed for 4 hours at a temperature of 85°C.

At 70 p.c. methane hydrolysis of grape skin used 15 ml of 70 p.c. methanol extract, 2 ml of methanol, 2.5 ml HCl, and 5.5 ml of distilled water; in 50 p.c. methanol with 2 p.c. HCl hydrolysis of grape skin used 15 ml 50 p.c. - methanol extract, 5 ml of methanol, 2.2 ml of HCl and 2.8 ml of distilled water. At the end of the process, the volume of the hydrolysate is brought to 50 ml at 1.2 m HCl of the mixture in 25 p.c. methyl alcohol. Then, after microfiltration, it is analyzed.

Chromatography is performed by HPLC and elution program using Supelco C-18 Calon (5 µm 25 cm × 4.6 mm). Flow rate 1 ml/min. When determining the wavelength is 280 nm, and for anthocyanidins, the wavelength is 520 nm. Kalon 10 minutes before injection of each sample is washed with 100% methyl alcohol and infused for 10 minutes.

Results and Dicsussion

Among the grape varieties grown in the Western region of Azerbaijan, a wide range of native and introduced grape varieties is concentrated. In the course of the research were used local grape varieties, such as Bahira and Madrasas, as well as imported as Merlot and Isabella. The varieties were processed separately and after separating the juice, the seeds were used. It turned out that the indicators of physical and chemical composition for individual elements of the bones have different estimates. This was influenced not only by the individual characteristics of the variety but also by the growing conditions and agrotechnical work carried out. Apparently, the dry substance in the composition of grape skins varied in the range of 14.0-31.0 p.c. depending on the variety, and it was formed from many compounds (**Table 1).**

One of the important compounds in seed pectin samples is pectin substances. It turned out that pectin substances are distributed unevenly in the seeds, skin and chaff of the seeds. In the Merlot and Madras grape varieties, the amount of pectin substances was significantly higher than in the Bayanshir and Isabella varieties.

Madrasa and bahira are one of the oldest grape varieties grown in Azerbaijan. At the same time, these varieties are grown not only in our Republic, but also far beyond its borders. In our country, it is grown in the Aran zone, in the foothills and mountain areas. Different wavelengths of spectral skin extracts obtained from white and red grape varieties were determined **(Figures 1 and 2).**

Table 1 Physical and chemical composition of grape skins in various grape varieties.

Composite indicator	Grape variety			
	Bayanshira	Izabella	Madrasa	Merlo
Dry ingredients, p.c.	14,0	17,1	25,1	31,0
Proteins, mg/cm^3	5,4	6,2	6,9	7,5
Total nitrogen, mg/dm^3	6,3	6,9	7,9	8,7
Vibrating acids, p.c.	6,5	6,4	6,7	7,3
The amount of hemicellulose, p.c.	4,6	5,1	5,8	6,7
Vitamin C, mg/100g	4,0	5,1	4,8	5,0
Lignin, p.c.	0,11	0,20	0,22	0,25
Pectin, p.c.	0,20	0,30	0,36	0,40
Flavonoids, p.c.	0,35	0,86	1,1	1,40
Anthocyanins	0,30	0,83	1,1	1,40
Phenolic compounds, mg/ 100 cm^3	0,55	1,4	1,8	2,7

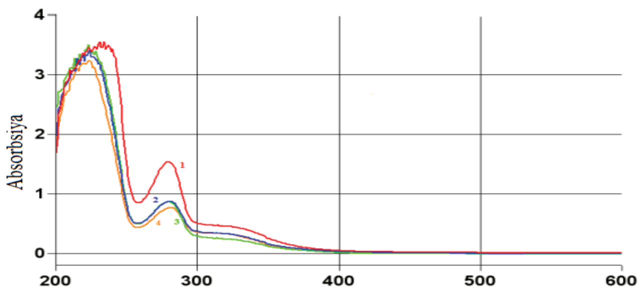

Figure 1 Spectra of the skin extract of the Bayanshira grape variety 2 p.c. hydrochloric acid in 1-50 p.c. methyl alcohol; 2-70 p.c. methyl alcohol; 3-50 p.c. methyl alcohol; 4-80 p.c. methyl alcohol.

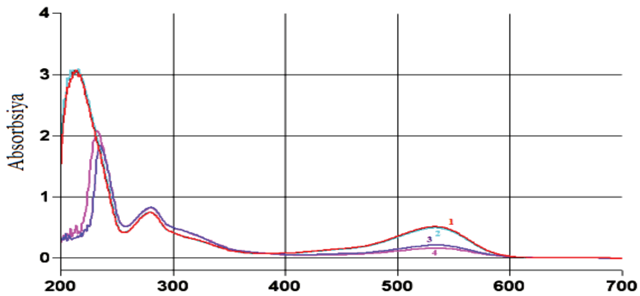

Figure 2 Spectra of the skin of Madrasa grape extract 2 p.c. hydrochloric acid in an amount of 1-50 p.c. methanol; 1 p.c. hydrochloric acid in 2- 50 p.c. methanol; 2 p.c. acetic acid in 3-50 p.c. methanol; 1 p.c. acetic acid in 4-50 p.c. methyl alcohol

When looking at the photos, it is clear that the most suitable solvent for the Bayanshir grape variety was 50 p.c. solution of methyl alcohol with 2 p.c. hydrochloric acid, while in the spectrophotometric developments that were not detected, preference was given to a 70 p.c. solution of methyl alcohol to ensure ease of operation **(Figure 1).**

It was found that the most suitable solvent for red grape skin extracts is 2 p.c. hydrochloric acid in 50 p.c. methyl alcohol **(Figure 2).** The study of chromatograms of peel extracts showed that there were not many absorbing compounds at the 280 nm wavelength and that the amount of anthocyanin detected at the 520 nm wavelength was predominant **(Figure 3).**

Because of the possibility that the anthocyanins in the peel may belong to very different types of glycosides, and because of the difficulty of complying with the standards of all of them, the peel extracts were hydrolyzed, and the anthocyanidins of delphinidins, cyanides, peonidin and malvidin were found in hydrolysates with standard additives. In this regard, it can be said that the glycosides of 4 anthocyanins mentioned in the peel extracts are also present. Grape seeds belong to the remnants of juice and wine. Grape seeds make up 38-52 p.c. of the dry matter. This corresponds to 3-5 p.c. of the mass of grapes. The amount of dry matter in the seeds varied from 51.2 to 61.6 p.c. depending on the variety **(Table 2).**

According to the study, the total amount of nitrogen is 22.8-41.2 mg/cm^3, cellulose 26.1-31.1 p.c., vitamin C 1.96-2.39 mg/100 g and pectin 0.30-0.66 p.c. The number of phenolic com- pounds was many times higher in the Madras and Merlot grape varieties than in the Bayanshira and Isabella. Among the red grape varieties, in comparison, the indicators of the Madrasa variety were lower than those of the Merlot variety. If you look at the individual elements of the berry, it becomes clear that the main number of phenolic compounds is in the skin and seeds, and a small part - in the chaff. The main mass of lignin is contained in the seeds (16.5-28.5 p.c.), and a small amount - in the skin (0.11-0.25 p.c.).

As you can see, the largest amount of biologically active substances (polyphenols, vitamins, organic acids) falls on the Merlo's and Madrasa's grape varieties. Biologically active substances are mainly found in the skin and seeds. As a result of the analysis, red Merlot, Madras, and Isabella grape varieties were selected to produce an extract rich in biologically active substances, while Bayanshiri was selected from white grapes. Grape seeds were obtained from different varieties of 1-4 p.c. depending on the mass of the bunch. We managed to get 21-38 p.c. of seeds from fresh grapes and up to 62 p.c. from dried grapes. The seed, separated from the pod, has an endosperm that is covered with a thin shell of the tannic cuticle. The results of studies of the amount of protein and fat in samples of seeds of various grape varieties are shown below. It was found that the amount of protein in the varieties varied between 7.0-11.2 p.c. **(Figures 4 and 5).**

As you can see, the amount of protein in the varieties varied significantly. The Madrasa variety showed an increase of 3 per cent compared to Merlot and about 4 per cent compared to Isabella seeds. The amount of oil was varied in the range 5.0 to 7.4 per cent depending on grade. The oil content in the seeds of the madrasa variety was higher than that of the other two varieties. This should be considered as an important factor to consider when processing them **(Figure 4).**

However, research has shown that the useful properties of seeds do not end there. Studies have shown that seed samples are also a source of rich phenolic compounds. The results of studies of various forms of phenolic compounds are shown in the following diagrams **(Figures 5-7).** The total amount of phenolic compounds in the seed samples ranged between 2950-4560 mg/kg^{-1}, and the highest indicator in this respect was observed in the Madrasa variety **(Figure 5).**

The number of flavonoids was 490 in grape seeds obtained from the Madrasa variety, 410 in seeds obtained from the Merlot variety, and finally 256 mg/kg^{-1} in Isabella, according to the sequence observed in the total number of phenolic compounds **(Figure 6).**

The number of anthocyanins differed from the number of phenolic

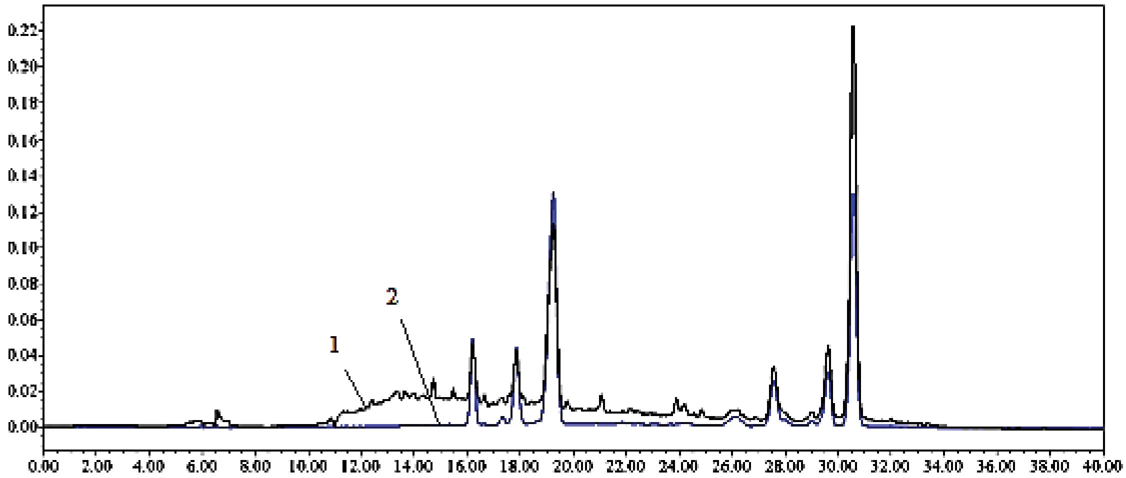

Figure 3 Chromatogram of bark hydrolysate in the Madrasa grape variety 1-280 nm and 2-520 nm.

Table 2 Physico-chemical composite indicators of seeds in various grape varieties.

Composite indicator	Grape variety			
	Bayanshira	izabella	Madrasa	Merlo
Dry ingredients, p.c.	51,2	57,4	59,4	61,6
Total nitrogen, mg/cm^3	22,8	35,6	39,4	41,2
Proteins, mg/cm^3	19,6	29,4	31,3	36,5
Cellulose, p.c.	26,1	28,9	30,2	31,1
Hemicellulose	9,2	11,2	10,2	10,6
Vitamin C mg/100 g	1,96	2,39	2,19	2,16
Vaccine, p.c.	1,8	2.6	3.7	4,2
Pectin, p.c.	0,30	0,51	0,58	0,66
Lignin, p.c.	16,5	25,1	26,9	28,2
Flavonoids p.c.	1,2	2,48	3,67	3,96
Anthocyanins, p.c.	0,60	0,75	0,83	0,94

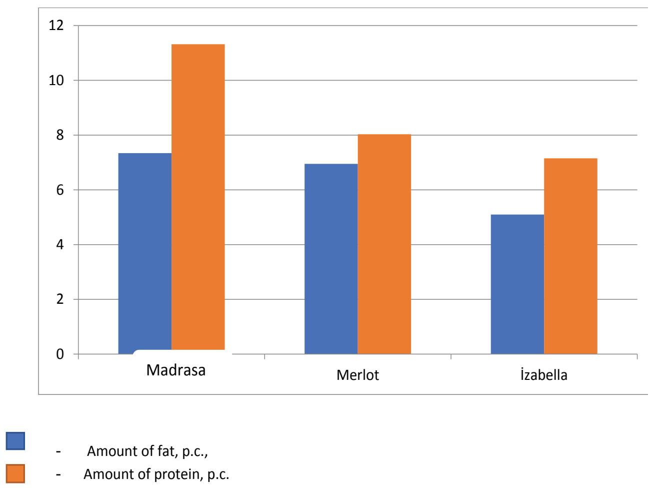

Figure 4 Amount of fat and protein in seed samples by variety (%).

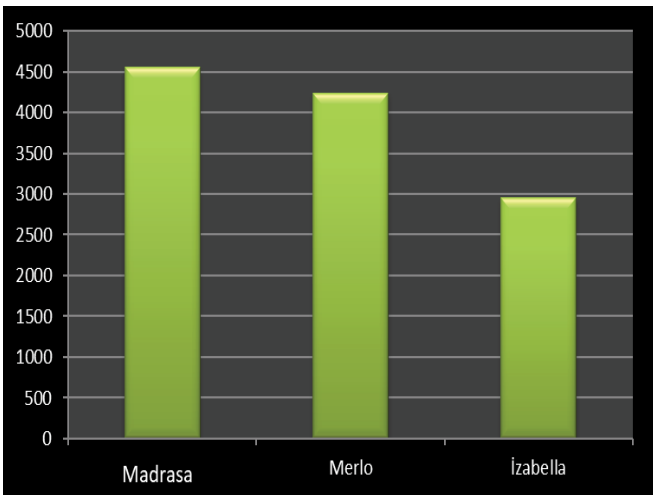

Figure 5 Number of phenolic compounds in seed samples (mg/kg^{-1}).

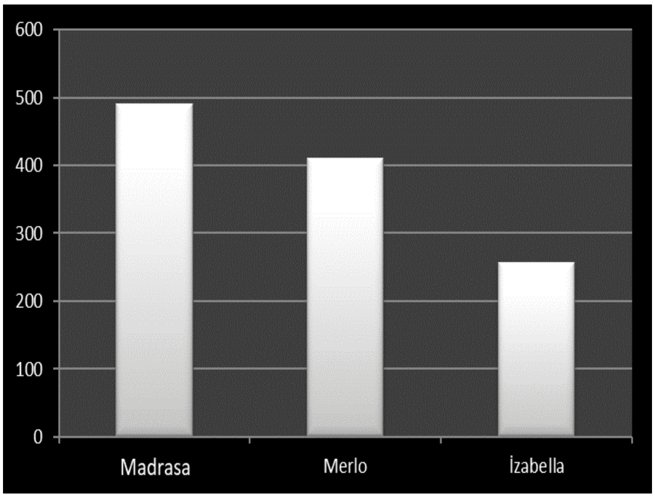

Figure 6 The number of flavonoids in samples of seed (mg /kg^{-1}).

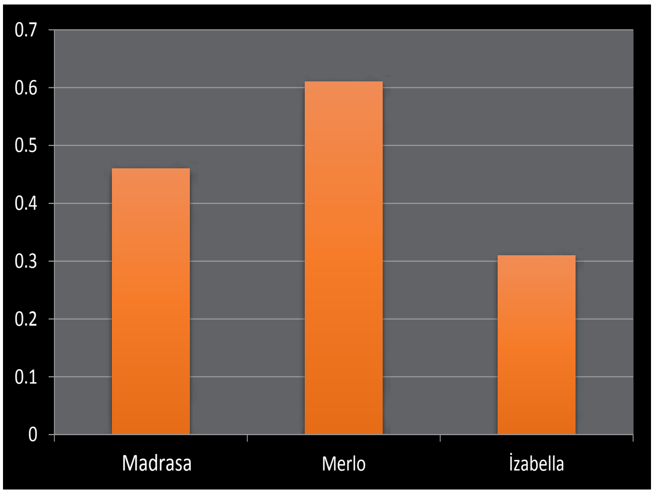

Figure 7 Number of anthocyanins in seed samples (mg/kg^{-1}).

compounds and flavonoids. Thus, the number of anthocyanins in the seeds of the Merlo grape variety was 0.61 mg/kg^{-1}, in the seeds of the Madras variety-0.46, and in the Isabella 0.31 mg/kg^{-1}. Seeds from Isabella are also the last in the number of other phenolic compounds. As studies have shown, the seed samples were rich not only in phenolic compounds but also in fats and proteins **(Figure 7).**

Thus, the analysis of the structural components of seeds (skins, seeds) obtained during the processing of some native and introduced varieties grown in the Western region showed that they have a rich composition. These components are very different in composition. As we have already mentioned, the method of processing grapes, varietal characteristics, and the degree of compression of the pulp also play a big role.

Studies on the extraction of substances from unfermented components have produced extracts rich in sugar, nitrogen, pectin, phenolic compounds, oils, cellulose, minerals, and other substances. Extracts obtained in various technological modes using various extractants were used, and positive results were obtained in the production of various types of functional foods.

Conclusion

The main content of biologically active substances (polyphenols, vitamins, organic acids) is the skin and seeds of grapes; the main mass of lignin was in the seeds and much less in the skin. Depending on the purpose of use, it is considered appropriate to use red Merlot, Madras, and white Bayanshira grapes, and for flavored products - extracts of the seeds of pink Isabella grapes. Preliminary studies on the production of functional foods (including juices and wines) from grape seed extracts obtained using various extractants have yielded positive results.

Conflict of Interest

Authors declare no conflict of interest.

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